

Emiel Hensen, Prof. Dr.

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Research

The research of Emiel Hensen focuses on the fundamental aspects of catalyzed reactions relevant to clean and sustainable processes for the production of fuels and chemicals. The aim hereby is to identify active sites and understand reaction mechanisms. The working approach is to combine advanced *operando* characterization methods - X-ray photoelectron spectroscopy, X-ray absorption spectroscopy, vibrational spectroscopy applied to well-defined catalyst model systems, theoretical modeling (density functional theory, microkinetics); and performance testing (kinetics, high-throughput methods, transient techniques), to guide the design and synthesis of nanoscopically organized and well-defined chemically functionalized catalytic solid materials. The materials explored include primarily highly structured porous materials containing reactive centers such as protons, metal ions and metal, metal oxide and metal sulfides clusters. Applications are directed towards the improvement of current industrial chemical processes and novel processes based on renewable feedstock such as biomass. Catalytic target reactions are methane activation, the Fischer-Tropsch reaction, conversion of biogenic molecules such as sugars and lignin, and metal-support cooperativity in selective oxidation. In these areas of research Hensen has made many innovative, internationally recognized scientific contributions. Hensen has pioneered the fields of Lewis-acid catalysed conversion of sugars, catalytic upgrading of lignin, synthesis of hierarchical zeolites, and microkinetics simulations of heterogeneous reactions.

Biography

Emiel Hensen received his master degree in chemical engineering and chemistry from Eindhoven University of Technology (TU/e) in 1994. In 2000 he obtained his PhD from the same university in the field of molecular heterogeneous catalysis under the supervision of professors Rutger van Santen and Rob van Veen. He then took up an assistant professor position with Prof. Berend Smit at University of Amsterdam. In 2001 he returned to TU/e as an assistant professor and he was promoted to associate professor in 2008. From 2006-2008 he was a visiting research scientist at the Shell Research and Technology Center Amsterdam (The Netherlands). Since July 2009 Hensen is full professor of inorganic materials chemistry at TU/e. He was a visiting professor at Katholieke Universiteit Leuven (Belgium) from 2001 until 2016 and a visiting professor at Hokkaido University (Japan) in 2016. Currently, he is a visiting professor at Xiamen University in China. He is member of the management team of the gravitation program Multiscale Catalytic Energy Conversion, member of the Advanced Research Center Chemical Building Blocks Consortium and chairman of the Netherlands Institute for Catalysis Research (NIOK). Hensen is currently dean of the TU/e department of Chemical Engineering and Chemistry.

Awards and personal grants

- Vici Laureate (Personal research grant of the Netherlands Organization for Scientific Research, 2014)
- Top Grant (Excellence research grant of the Netherlands Organization for Scientific Research, 2013)
- Vidi Laureate (Personal research grant of the Netherlands Organization for Scientific Research, 2008)
- Casimir Laureate (Personal grant for the exchange of researchers between academia and industry, 2006)
- Veni Laureate (Personal research grant of the Netherlands Organization for Scientific Research, 2003)

Five signature publications

- P. Liu and E.J.M. Hensen, 'Highly Efficient Au/MgCuCr₂O₄ Catalyst for Gas-Phase Oxidation of Ethanol to Acetaldehyde', *Journal of the American Chemical Society* 135 (2013) 1432-1435.
- L. Gao, Y. Cui, R.H.J. Vervuurt, D. van Dam, R.P.J. van Veldhoven, J.P. Hofmann, A.A. Bol, J.E.M. Haverkort, P.H.L. Notten, E.P.A.M. Bakkers and E.J.M. Hensen, 'High-efficiency InP-based photocathode for hydrogen production by interface energetics design and photon management', *Advanced Functional Materials* 26 (2016) 679-686 (cover).
- X. Zhu, M.G. Goesten, A.J.J. Koekkoek, B. Mezari, N. Kosinov, G. Filonenko, H. Friedrich, R. Rohling, B.M. Szyja, J. Gascon, F. Kapteijn and E.J.M. Hensen, 'Establishing hierarchy: the chain of events leading to the formation of Silicalite-1 nanosheets', *Chemical Science* 7 (2016) 6506-6513.
- N. Kosinov, A.S.G. Wijpkema, E. Uslamin, R. Rohling, F.J.A.G. Coumans, B. Mezari, A. Parastaei, A.S. Poryvaev, M.V. Fedin, E.A. Pidko and E.J.M. Hensen, 'Confined Carbon Mediating Dehydroaromatization of Methane over Mo/ZSM-5', *Angewandte Chemie International Edition* 57 (2018) 1016-1020 (cover).
- J.X. Liu, Y. Su, I.A.W. Filot and E.J.M. Hensen, 'A linear scaling relation for CO oxidation on CeO₂-supported Pd', *Journal of the American Chemical Society* 140 (2018) 4580-4587 (cover).